

Sustaining mechanism of photonic crystal cavity modes coupled to single quantum dots

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We present a systematic study of the coupling mechanism between cavity modes of a two-dimensional L3-type [1] photonic crystal slab (PC) and a single InAs/GaAs self-assembled quantum dot (QD). Benefiting from our technique to control deterministically the PC-QD coupling [2], we engineered two limit devices: (i) the single QD aligned with the electric field maximum of the 1st order PC mode and far-red-detuned from the QD excitons and (ii) the single QD aligned with a minimum of the electric field maximum of the 1st order PC mode. In the first case, decreasing the detuning from 18 nm to zero in steps of 2 nm, we parsed the mode emission under QD and 2nd order mode resonant pumping. Measurements of the lifetime and second-order correlation function of QD exciton and 1st order mode as function of detuning showed a remarkable as well as unexpected behavior of the cavity mode sustaining mechanism. Nonetheless, part of the theoretically predicted behavior of the coupled PC-QD system is preserved when the system is driven into resonance or, as presented in the second case, when the QD probes the spatial variation of the cavity mode electric field.

[1] Y. Akahane *et al.*, *Nature* **425**, 944 (2003).

[2] A. Badolato *et al.*, *Science* **308**, 1158 (2005).